Research scientist Luann Becker visited Idaho National Laboratory in early November to discuss her work on mass extinctions and the search for life on Mars.

Johns Hopkins scientist searches for clues to the rise and fall of life

by Roberta Kwok, *Research Communications Fellow*

Animals that flourished on Earth 250 million years ago were struck down by a mysterious catastrophe that caused most of the planet's species to suddenly vanish. And in other parts of our solar system, scientists speculate, microscopic organisms may have once crept into being and then died out, leaving only faint traces for us to detect.

These ebbs and flows of life in the universe have long intrigued Luann Becker, a research scientist at Johns Hopkins University who visited Idaho National Laboratory last month to share her latest work. Becker has weathered criticism for her claims that the largest extinction event in Earth's history, known as the Great Dying, may have been triggered by a giant asteroid impact. She's also investigating the possibility of life beyond our planet with an instrument that will look for remnants of ancient bacteria on the European Space Agency's next Mars mission. During her INL visit, Becker described her most recent advances on these two projects and met several lab researchers in an effort to spark future collaborations.

Becker learned about the research of several INL scientists during her visit, including Timothy McJunkin from the Energy Efficiency and Industrial Technology group.

Scientists agree that the demise of the dinosaurs 65 million years ago was probably caused by an asteroid that collided with the Earth. But less is known about the Great Dying, about 190 million years earlier, which killed 90 percent of all ocean life and 85 percent of species on land. While geologists had proposed several possible causes, ranging from volcanic activity to climate change to an asteroid impact, no one knew for sure what had happened.

To investigate, Becker studied sediment layers formed during the extinction and discovered peculiar soccer-ball-shaped carbon molecules called fullerenes or buckyballs. These fullerenes contained a strange mix of gases that didn't match what one would expect on Earth. Becker's group suggested the fullerenes had been created in carbon-rich stars, where they trapped extraterrestrial gases, got spewed out upon the star's collapse and hitched a ride on an Earthbound meteorite, which proceeded to wipe out most plant and animal life on the planet.

Becker has searched for geological traces of mass extinctions in sediment layers all over the world, including China, Japan, Australia and Antarctica. Photo credit: Luann Becker.

The team's report provoked skepticism from scientists who had previously relied on different molecules for evidence of asteroid collisions and didn't believe fullerenes could survive intact for 250 million years. "We really got bombarded for saying we should rely on something as exotic as fullerenes to support an impact event," Becker said at one of her INL talks.

Becker has continued to test her hypothesis by looking for the ultimate evidence: the crater left behind by the killer asteroid. She analyzed cores from one possible impact site off the coast of Australia and found deformed minerals nearby that may have been warped by a violent shock. While many scientists remain unconvinced that an asteroid was the true trigger for the extinction, Becker said she's prepared to be patient.

"These things don't happen overnight," she said. "Let time takes its course, and maybe we'll come to a solution."

In the meantime, Becker is turning her sights to another planet where life may have also begun and then faded away. She's designing an instrument called the Mars Organic Molecule Analyzer, or MOMA, that is slated to launch on the European Space Agency's ExoMars mission in 2013. The mission will be different from other attempts to find life on Mars because it will come equipped with a drill that can collect samples from 2 meters below the surface. By going underground, Becker hopes they can find organic molecules that may have been protected from the harsh Martian environment.

MOMA will look for these molecules using a technique called laser desorption ion-trap mass spectrometry. First,

the ExoMars rover will pull out small cores, crush them and put the remains on a carousel to various instruments. MOMA will then fire laser light at the crushed rock to lift organic molecules off the sample's surface. The molecules will be shuttled through a device that fragments them into charged particles, which scientists can analyze for evidence of organic matter.

To ensure that MOMA will operate properly in space, Becker has tested parts of her instrument in Antarctica, which has a cold, dry environment similar to Mars. She faces other challenges as well: The entire ExoMars rover must operate on the power of a 100-watt lightbulb. But for Becker, the difficulties are worth it.

"How many times do you get to go to Mars and take an instrument?" she asked. "Would you turn it down? No. But are you worried? Yeah, you're worried all the time."

In addition to giving two talks, Becker met about a dozen scientists from INL's Energy and Environment group during her visit. She said she was "very impressed" by the lab's research and may pursue collaborations in future. In particular, INL scientist Jill Scott's work on laser desorption mass spectrometry may help Becker plan her analyses on Mars. "I hope to work with her very closely as we test MOMA," Becker said.

Becker is developing an instrument to analyze Martian rock samples on a European Space Agency mission. Photo credit: V. Doroshenko, SESI.

Listen to a podcast Q&A with Becker or read the transcript.

Take a multimedia tour of Becker's research in Antarctica.
Read a Scientific American article by Becker about mass extinctions.
Find out more about the European Space Agency's ExoMars mission.

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